REMARKS

With the above amendments, claims 1-9 are pending in the application. Claims 1 and 3-6 are hereby amended. No new matter is being added.

Claim Rejections under 35 U.S.C. § 102

Hyodo et al

Claims 1-6 stand rejected as anticipated by Hyodo et al (USP 6,021,250). Applicants respectfully submit that this rejection is now overcome in relation to the claims as amended hereby.

Amended claim 1 now recites as follows.

1. A method for encoding and decoding a video sequence in which a keyframe is used to bi-directionally predict frames in the sequence, the method comprising:

coding the keyframe independently of other frames in the sequence; and

predicting a prior frame occurring before the keyframe using data from the keyframe **and not from any other keyframe**; and

predicting a subsequent frame occurring after the keyframe using the data from the keyframe **and not from any other keyframe**.

(Emphasis added.)

As shown above, amended claim 1 is now limited to a method having the steps of "predicting a prior frame occurring before the keyframe using data from the keyframe **and not from any other keyframe**" and "predicting a subsequent frame occurring after the keyframe using the data from the keyframe **and not from any other keyframe**."

This amendment is supported in the specification, for example, in FIG. 3a and the corresponding description. For convenience of reference, FIG. 3a is reproduced below.

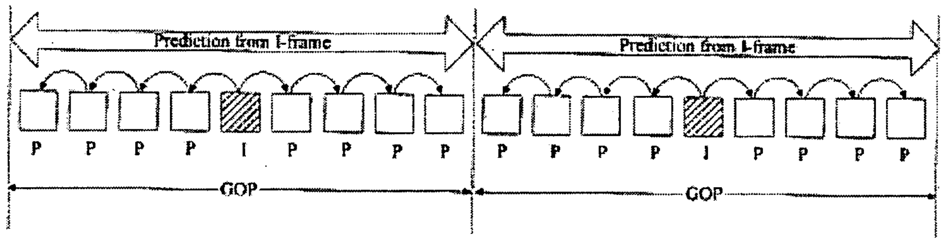


Fig. 3a

FIG. 3a is described in the specification on page 12, lines 1-11, as follows. As emphasized below, the bi-directional prediction is **from a single keyframe.**

> Fig. 3a illustrates the concept of predicting bi-directionally **from a single I-frame** in accordance with an embodiment of the invention. Two GOPs from a video sequence are shown, and for each GOP the I-frame is taken to occur in the middle of the GOP. Note that in general the total number of P-frames in a GOP and the proportion of P-frames occurring before and after the I-frame may vary. P-frames extend in either temporal direction from the central I-frame. Backwards predictions are used to predict the P-frames that precede the I-frame, and forward predictions are used to predict the P-frames that follow the I-frame (in the usual manner). Note that under this conception P-frames are frames that are predicted from a single direction, but that direction need not be the forward direction (in contradistinction to the MPEG standards and other known video coding standards).
>
> (Emphasis added.)

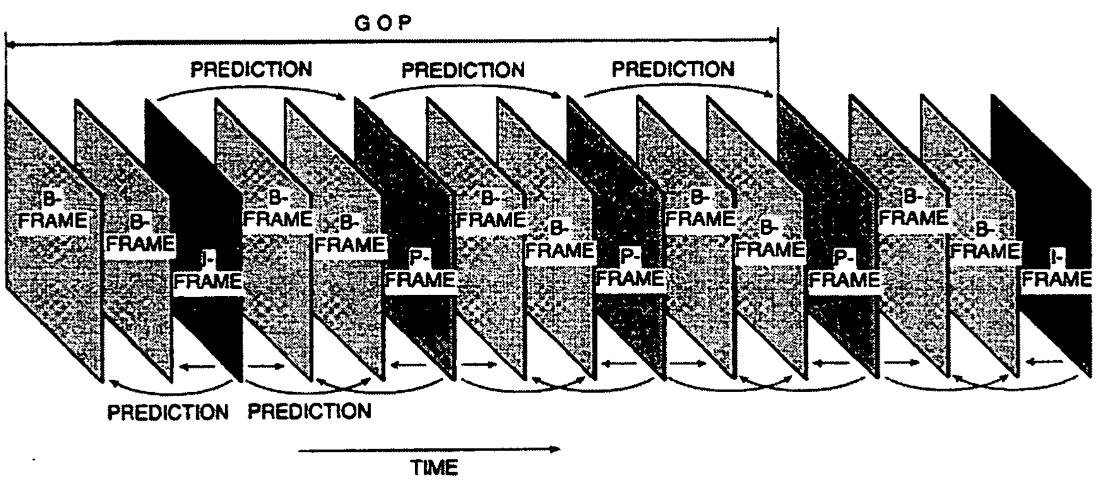
The advantage of such a technique is described in the specification, for example, on page 10, lines 1-4, which recites as follows.

> The first advance involves restructuring the order in which predicted frames (P-frames) and/or bi-directionally predicted frames (B-frames) are **predicted from a**

> **single keyframe**. In particular, a keyframe is taken at the middle of a group of pictures (GOP) and used to predict P-frames occurring both before and after that keyframe.
>
> (Emphasis added.)

In contrast, Hyodo et al teaches bi-directional prediction from two keyframes (I-frames). This is shown in FIG. 1 of Hyodo et al, which is reproduced below for convenience of reference.

FIG.1
(PRIOR ART)



As shown above, Hyodo et al teaches using data from two I frames to predict P and B frames between the two I frames.

For at least the above-discussed reasons, amended claim 1 is now patentably distinguished over Hyodo et al.

Claims 2-6 depend from claim 1. As such, claims 2-6 are patentably distinguished over Hyodo et al for at least the same reasons discussed above in relation to claim 1.

Yu et al

Claims 7-8 stand rejected as anticipated by Yu et al (US 2004/0042548). Applicants respectfully traverse this rejection.

Claim 7 recites as follows.

7. (original) A method for allocating bits to a keyframe during video encoding, wherein **effects of a plurality of keyframe bit allocations on quality of a predicted frame are measured**, and wherein **said effects are used to determine a near optimal keyframe bit allocation**.

(Emphasis added.)

As shown above, claim 7 is limited to a method wherein "**effects of a plurality of keyframe bit allocations on quality of a predicted frame are measured**" and "**said effects are used to determine a near optimal keyframe bit allocation**."

This amendment is supported in the specification, for example, in FIGS. 4 and 5 and the corresponding description. For convenience of reference, FIGS. 4 and 5 are reproduced below.

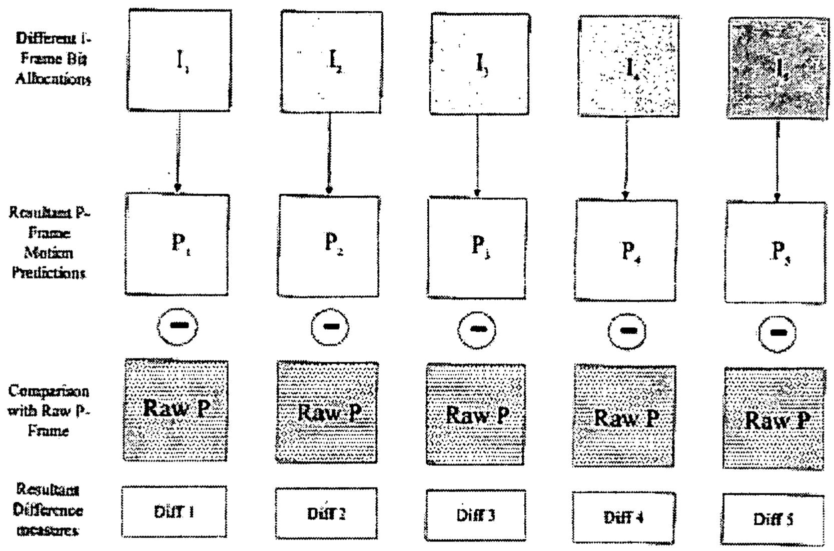


Fig. 4

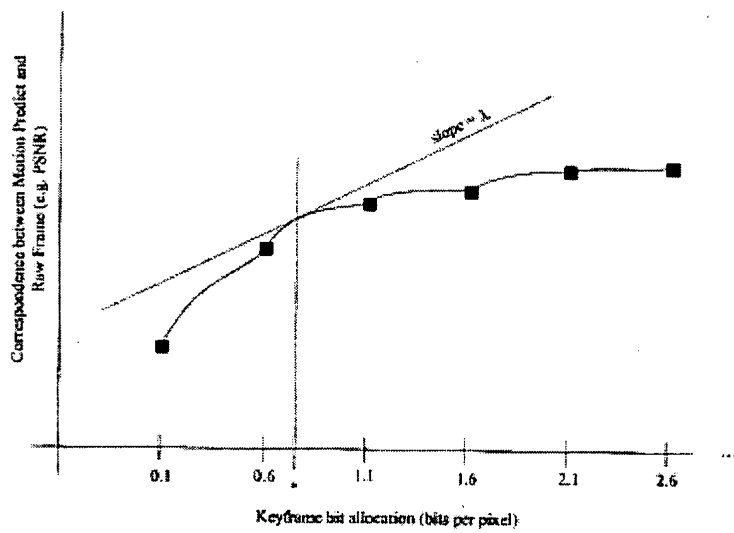


Fig. 5

FIGS. 4 and 5 are described in the specification on page 13, line 26 through page 14, line 25, as follows. As emphasized below, the effects of a plurality of keyframe bit allocations on quality of a predicted frame are measured (for example, using a peak

signal-to-noise ratio), and those effects are used to determine a near optimal keyframe bit allocation (for example, using a slope criterion).

> Fig. 4 illustrates a heuristic used to gather data from which an optimal keyframe bit allocation can be determined in accordance with an embodiment of the invention. **The video encoder first encodes a given keyframe at a plurality of bit allocations.** For example, in one embodiment the keyframe is encoded using JPEG2000 at for instance 0.1, 0.6, 1.1, 1.6, 2.1, 2.6, and 3.1 bits per pixel. In general, the technique used for keyframe encoding and the choices of bit allocations may vary. The encoder then decodes each of these encoded keyframes to produce decompressed keyframes that would be available to a decoder.
>
> The encoder next uses each decompressed keyframe to predict the first subsequent P-frame in the sequence. Preferably at this stage the encoder only performs a motion-compensated prediction and does not carry out further steps to correct the resulting prediction. However, in general any prediction technique may be used at this step. The encoder then compares each of these first predicts to the corresponding raw frame from the uncompressed video sequence. **Some measure of the success of each prediction is made so that the effectiveness of the various keyframe encoding bit allocations can be compared. In one embodiment, the peak signal-to-noise ratio (PSNR) is computed for each predicted P-frame relative to the raw frame. In Fig. 4, these comparison measures between the various predicted frames and the raw frame are called Diff 1, Diff 2, and so on.**
>
> Fig. 5 illustrates a plot of prediction qualities (e.g. PSNR values) against keyframe encoding bit allocation in accordance with an embodiment of the invention. Generally higher bit allocations for keyframe encoding result in higher prediction qualities, though the returns eventually diminish. **A slope λ is used to represent the optimal (or near optimal) tradeoff between increasing the keyframe quality and reducing the bits available for coding predicted frames.** This optimal slope λ is determined empirically. An interpolation is made between each consecutive pair of points in the quality versus bit rate plot to estimate the quality for all keyframe bit allocations within a certain range. In one embodiment, a logarithmic function of the form $A\ \log(x) + B$ is used to model the curve lying between each pair of data points. **The point on the resulting curve having slope equal to λ is located, and the bit allocation corresponding to this point on the curve is selected as the optimal keyframe bit allocation.**

(Emphasis added.)

In contrast, Yu et al teaches **setting fixed target numbers** of bits for encoding each of the I, P, and B frames. See, for example, paragraphs [0051] and [0052], which are reproduced below for convenience of reference.

[0051] where ux is the minimal bits size unit and is described further below. Therefore, in accordance with one embodiment the present invention, the target number of bits T_i, T_p and T_b for encoding each of I, P or B frame is as follows:

$$
\begin{array}{l}
\text{if (SavedBits < BankLimit) \{} \\
\quad\quad T_i = T_{itm5} \times 0.9; \\
\quad\quad T_p = T_{ptm5} \times 0.95; \\
\quad \text{or} \quad T_b = T_{btm5} \times 0.98; \\
\} \\
\text{else\{} \\
\quad\quad T_i = T_{itm5}; \\
\quad\quad T_p = T_{ptm5}; \\
\quad \text{or} \quad T_b = T_{btm5}; \\
\}
\end{array}
\quad (4.2)
$$

[0052] where T_{itm5}, T_{ptm5} and T_{btm5} are the target number of bits for encoding each of I, P and B frames in conformity with the TM_5 standard (see equations (1.3)). Accordingly, in this embodiment, 90% of the bits targeted for encoding an I frame is used to encode the I frame and the remaining 10% of the bits are accumulated in the bit bank. Similarly, 95% of the bits targeted for encoding a P frame is used to encode the P frame and the remaining 5% of the bits are accumulated in the bit bank. In a similar manner, 98% of the bits targeted for encoding a B frame is used to encode the B frame and the remaining 2% of the bits are accumulated in the bit bank.

As shown above, Yu teaches **setting fixed target numbers** of bits T_I, T_P, and T_B for encoding each of the I, P, and B frames, respectively, in accordance with the TM_5 standard. In contrast, the claimed invention requires that "effects of a plurality of keyframe bit allocations on quality of a predicted frame are **measured**" and "**said effects are used to determine a near optimal keyframe bit allocation**."

For at least the above-discussed reasons, amended claim 7 is now patentably distinguished over Yu et al.

Claim 8 depends from claim 7. As such, claim 8 is patentably distinguished over Yu et al for at least the same reasons discussed above in relation to claim 7.

Claim Rejections under 35 U.S.C. § 103

Claim 9 stands rejected as unpatentable over Yu et al in view of Hyodo et al. Applicants respectfully traverses this rejection.

As discussed above, amended claim 7 is patentably distinguished over Yu et al at least due to claim 1 reciting that "effects of a plurality of keyframe bit allocations on quality of a predicted frame are **measured**" and "**said effects are used to determine a near optimal keyframe bit allocation**." Neither Yu et al, nor Hyodo et al has such teachings.

Hence, for at least the above-discussed reasons, applicants respectfully submit that claim 9 is now patentably distinguished over Yu et al in view of Hyodo et al.

Conclusion

For at least the above reasons, it is respectfully submitted that claims 1-9 are now patentably distinguished over the cited art.

The Examiner is invited to telephone the undersigned at (408) 436-2111 for any questions. If for any reason an insufficient fee has been paid, the Commissioner is hereby authorized to charge the insufficiency to Deposit Account No. 50-2427.

Respectfully submitted,
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